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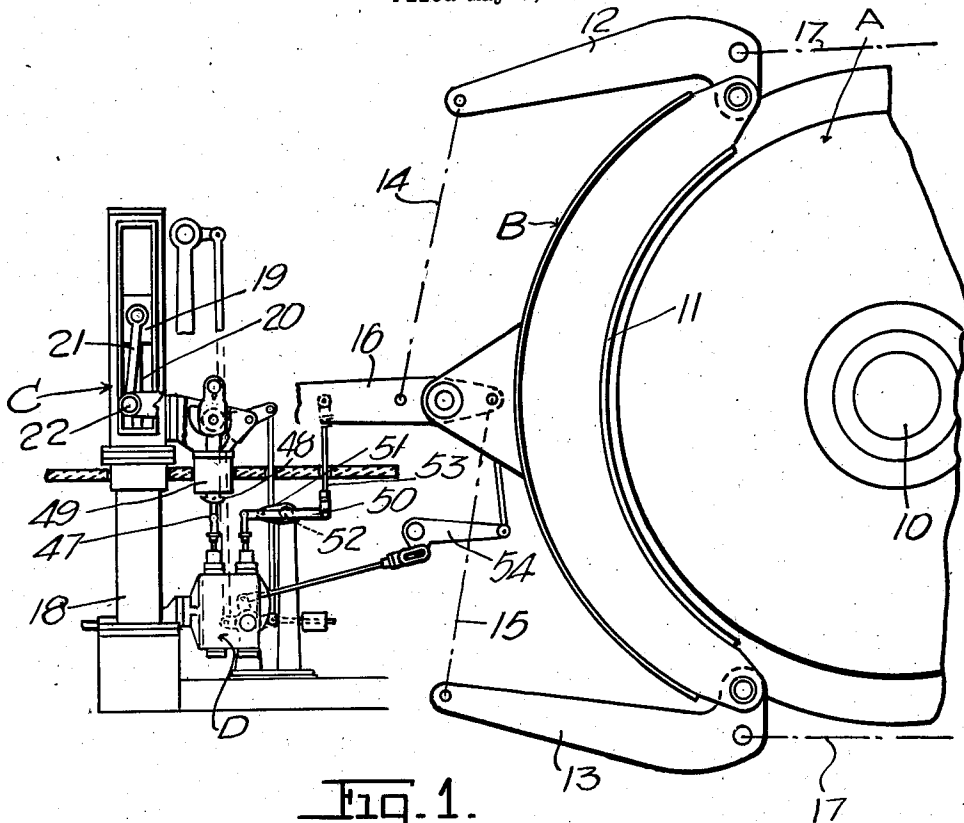


Fig. 1.

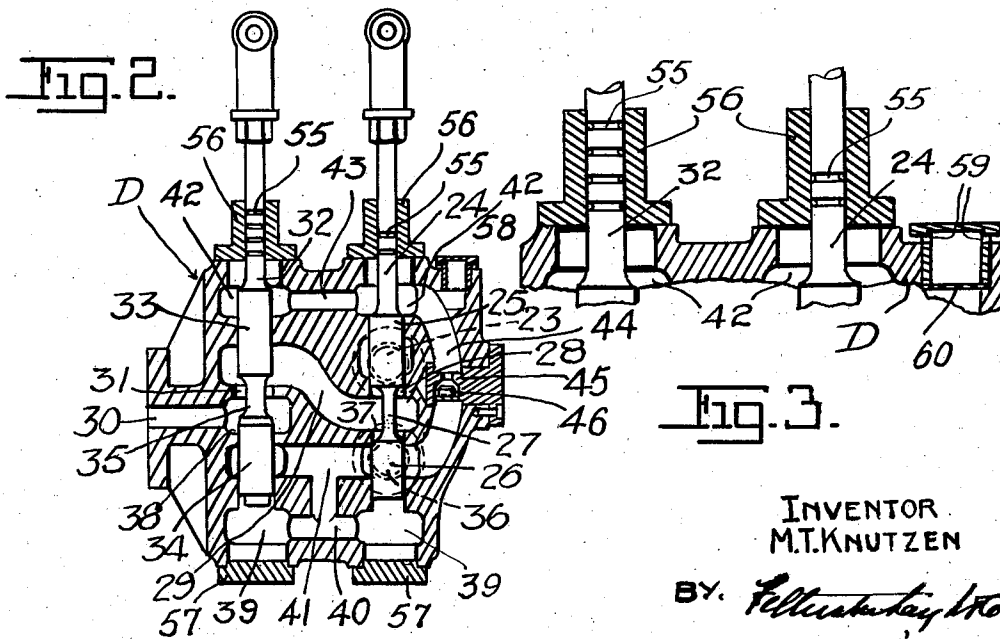


Fig. 3.

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FLUID CONTROL VALVE

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14 Claims. (Cl. 277—57)

This invention relates to fluid control valves.

Fluid control valves of the general type concerned have been used for a period of years and particularly in relation to the control of hoist mechanism for actuating the brakes of the hoist to full "on" position as required in normal operating conditions or under conditions of emergency. There have been, however, some disadvantages in the prior type of valve. On the one hand, its operation was such that the clutch of the hoist drum might be unclutched prior to the complete application of the brakes unless the control mechanism was very finely adjusted. On the other hand, due to sluggish operation of the valve caused by sticking of the valve plunger due to its packings, the brake might not be applied when required. The present invention overcomes the disadvantages of the prior type of valve and the effect of these problems as applied to hoist operation or the operation of any other type of mechanism controlled in a similar manner.

It is, therefore, an object of the present invention to devise a fluid control valve which avoids the necessity of packings, thus eliminating sluggish operation or sticking of the valve plungers due to the packings.

A further object of the invention is to provide a valve of this character wherein the construction of the valve is such as to provide for clean-cut instantaneous action of the valve mechanism in response to actuation during normal course of operation.

A still further object of the invention is to provide a valve of this character which is generally simple in construction.

With these and other objects in view, the invention generally comprises a valve casing having fluid inlet and outlet ports and a pair of valve plungers controlling said ports, one in the case of emergency and one in the case of normal operation designed to control the feeding of fluid to and from fluid operated means with which the valve is associated, the valve including a fluid operated check valve to insure sharp operation of the valve and to eliminate fluid pressure in parts of the valve, thus contributing to elimination of the use of packing or the like in the valve structure. The invention will be clearly understood by reference to the following detailed specification taken in conjunction with the accompanying drawing.

In the drawing—

Fig. 1 is a diagrammatic side elevation of the valve mechanism according to the present inven-

tion associated with mechanism for controlling the brake application of a hoist.

Fig. 2 is an enlarged transverse section taken through the valve body to show its operating parts; and

Fig. 3 is a further enlarged fragmentary detail of the upper part of the valve casing.

Referring to the drawing, the operation of the valve structure may be conveniently illustrated by referring to one of its fields of application, viz. a control of the brakes of a hoist. Referring particularly to Fig. 1, A indicates a hoist drum mounted on a shaft 10 driven from any suitable source of power to rotate the hoist drum. Associated with the hoist drum is brake mechanism B which may include the brakes 11 disposed on each side of the drum in opposed relation (one side not illustrated) the brakes being operated through the levers 12 and 13 which connect through suitable link structure illustrated by the dotted lines 14 and 15 with a main brake operating lever 16. The levers 12 and 13 are link connected beyond their points of fulcrum with the opposite brake mechanism, the link connection being illustrated by the dotted lines 17.

The main brake operating lever 16 is controlled by the mechanism C which comprises a fluid cylinder 18 having a piston therewithin which operates the cross-head 19 through its piston rod 20, the piston being lowered by gravity through weights (not shown) which may be connected with the cross-head and being raised by a fluid medium passed to and from the cylinder 18 by means of the fluid control valve D which will be referred to in detail hereinafter.

The cross-head 19 is connected by way of the links 21 to the free end of the main brake operating lever 16 as indicated at 22 so that if the piston within the cylinder 18 is lowered, the main brake operating lever 16 in lowering will pull the levers 12 and 13 which, by means of its link connections 17 with the opposite brake unit, will cause unit 11 and the opposite brake unit 45 to grip the drum and apply the brakes. However, upon raising the piston within cylinder 18 to its normal operating position when the hoist is operating, the main brake applying lever 16 will be positioned as shown in Fig. 1, in which position the brakes are released from the drum and it may operate.

The operative parts of the valve of the present invention are shown clearly in Figs. 2 and 3. A fluid inlet 23 is controlled by the valve plunger 24 which includes the piston members 25 and 26

connected by the reduced portion of the plunger 27. When the plunger is in its raised position, fluid may pass from the inlet 23 through the port 28 and through the passageway 29 to the feed passage 30 through the port 31. The latter port is controlled by a valve plunger 32 which has piston members 33 and 34 connected by a reduced portion 35, and in its raised position as shown in Fig. 2 will permit flow of fluid from the passageway 29 through the port 31 to the feed passage 30.

In the present illustration of the application of the valve, the feed passage 50 communicates with the cylinder 18 to supply fluid to the underside of the piston contained therein or to permit such fluid to flow back through the passage 30 to a discharge outlet 36 when the valve plungers are set in a position to permit communication between the feed passage 30 and the outlet 36. The lower piston 26 of plunger 24 controls the valve port 37, while the lower piston member 34 of plunger 32 controls the valve port 38, each of which ports when opened will permit flow of fluid directly to the discharge outlet 36. The lower portion of the valve casing contains the chambers 39 connected by the passage 40, which in turn is connected with the transverse passage 41. These passages are filled with fluid, the lower chambers being designed to balance the valve along with the upper chambers 42 connected by the passage 43 and the side passage 44 which is divided by a suitable partition 45 and contains therein a fluid actuated check valve 46. The lower end of passage 44 communicates with passage 41 and the discharge outlet 36.

Let it be assumed that this valve structure is connected, as shown in Fig. 1, with the brake operating mechanism for a hoist. In this connection the valve plunger 32 is connected as at 47 with the plunger 48 of a solenoid 49 which, during the operation of the hoist, is energized by an electrical circuit so that the valve plunger 32 will be in the raised position shown in Fig. 2. The valve plunger 24 is connected through a suitable link 50 pivoted at 51 to an arm carried on the shaft 52, the opposite end of the link being pivotally connected by the link 53 with the main operating lever 16 of the hoist brake mechanism. In the position shown in Fig. 1 where the main lever 16 is in normal position with the brakes released, the valve plunger 24 will be raised uncovering the port 28 permitting fluid to flow from the pressure system through this port through passageway 29, open port 31 and feed passage 30 to the bottom of the cylinder 18, thus maintaining the piston therein raised.

Let us assume, however, that an emergency has arisen such as the hoist travelling at overspeed or beyond position. These conditions are controlled by well known means which is generally known as "Lilly control mechanism" connected in circuit with the solenoid and also including a movable lever which may act to operate lever 54 and its connections to accelerate the operation of valve plunger 32 mechanically, which accelerative mechanism forms the subject matter of a copending application. However, with the operation of the Lilly control mechanism in an emergency the solenoid 49 is deenergized, thus releasing its plunger and causing said plunger and its connected valve plunger 32 to move downwardly. This closes the port 31 releasing the pressure through the feed passage 30 and venting such passageway through the port 38 and passageway 41 to the outlet 36. At the same time since the

passageway 41 and outlet 36 communicate with the lower end of passageway 44 the fluid discharging from the cylinder 18 in the gravity operated piston will immediately close check valve 46. This assures, therefore, that the fluid discharging from cylinder 18 will discharge through the port 36 positively and consequently a quick and instantaneous lowering of the piston in cylinder 18 results. Moreover, by reason of the fact that the check valve 46 prevents pressure being transmitted through the upper end of a passage 44 to the upper part of the valve casing, such part of the valve casing is not subjected to pressure. Therefore, I am able to provide a structure wherein it is not necessary to employ conventional packing or stuffing boxes for the plunger rods of the plungers 24 and 32.

With the lowering of the piston in cylinder 18, the main brake operating lever immediately lowers and through the links 14 and 15 pivoted on each side of the fulcrum of the lever 16, levers 12 and 13 are operated towards each other and acting through their link connections 17 with the opposed brake unit apply the brakes B to their full "on" position, thus stopping the hoist.

With the lowering of the main brake operating lever 16 the link 50 is caused to pivot on its fulcrum 51 raising valve plunger 24, but by reason of the fact that the port 31 is closed by plunger 32 and port 37 is closed by the reason of plunger 24 the fluid medium under pressure would have no effect.

When the abnormal conditions causing emergency operation of the valve have been corrected and the electric circuit is again established energizing the solenoid 49, the valve plunger 32 will be raised again to open port 31 and close port 38. Consequently since valve plunger 24 is in its raised position the pressure medium again immediately flows through port 31 to feed passage 30, thus forcing the piston in cylinder 18 back to its raised position and releasing the brakes.

The shaft 52 is designed to be rotated by means of a manual control lever (not shown) which controls the operation of an arm rigidly carried on shaft 52 and to which the link 50 is pivoted as at 51. Consequently, if the shaft 52 is rotated to normal brake applying position wherein the shaft 52 is rotated in an anti-clockwise direction, the arm and its pivot point 51 with the link 50 will be moved downwardly. The lowering of the fulcrum point 51 will force valve plunger 24 downwardly, thus cutting off port 28 and opening port 37. As a result the feed passage 30 through port 31 and passage 39 will be connected with the discharge outlet 36 so that the piston in cylinder 18 will immediately move downwardly under its weight and apply the brakes in a similar manner as that described in connection with the operation of plunger 32. Thus plunger 24 controls the brakes under normal conditions, while plunger 32 does the same work under abnormal conditions.

The operation of the valve plungers is similar to the operation in prior constructions. However, the salient features of the present valve lie in the fact that the plungers are disposed so that their operating connections are disposed upwardly from the casing instead of being suspended downwardly and with this is included a hydraulic pressure operated check valve 46 which prevents any pressure being applied in the upper portion of the valve casing so that in no instance is there

a fluid pressure which necessitates the use of packings.

In the present construction it is only necessary to employ oil grooves 55 in the plunger rods which maintain lubrication and accommodate any oil that might pass between the rods and their bushings 56, a more detailed arrangement of which is shown in Fig. 3. In the prior type of construction not only were the plunger rods and their bushings subjected to fluid pressure by reason of operation, but normally they were subjected to the gravity pressure of the fluid body within the valve. In the present structure, the bottom of the valve casing is completely sealed by suitable means such as the plugs 57.

In order to provide against the possibility of an air lock developing within the valve casing, I provide a breather valve 58 provided with the breathing openings 59 and preferably including a screen 60 to prevent the admission of foreign material to the valve. In consequence of this general arrangement, therefore, the valve plungers will always work freely and by reason of the fact that no packings are involved, the plungers will not be caused to stick as has been the case in prior practice, whereas the pressure relieving check valve 46 assures the positive and instantaneous discharge of the fluid medium through the port 36 when operation of the mechanism controlled requires this action.

While the valve of the present invention has been illustrated in conjunction with the operation of the brake mechanism of a hoist, it is obvious of course that it has a general application in other fields where fluid control of the kind in question is required.

It will, of course, be obvious that the invention is not confined to a valve employing a plurality of plungers but is also applicable to a valve employing one plunger as, for instance, the plunger 24 operating between the inlet and outlet 23 and 36 respectively wherein the passage 29 might form the feeding passageway instead of the feed passageway 30. Thus, such a structure would operate in exactly the same manner and provide a sharp acting packingless valve.

While the valve of the present invention has been illustrated in conjunction with the operation of the brake mechanism of a hoist, it is obvious of course that it has a general application in other fields where fluid control of the kind in question is required.

What I claim as my invention is:

1. A packingless fluid control valve comprising a casing having a fluid inlet and outlet, a valve plunger controlling the flow of fluid therethrough and having a part thereof projected through an upper portion of the casing, for operating connections, fluid drainage means in the upper portion of the valve communicating with said plunger to drain leakage fluid to the outlet and means operable by the pressure of discharging fluid passing through the valve, for isolating the upper portion of the valve from the pressure of said discharging fluid.

2. A packingless fluid control valve comprising a casing having a fluid inlet and outlet, a valve plunger controlling the flow of fluid therethrough, connecting upper and lower fluid chambers in the casing capable of draining leakage fluid from the upper chamber to the lower chamber, said valve plunger having a part thereof passing through said upper chamber, and projecting through the upper part of the casing for operating connections, said lower chamber being con-

nected with said outlet and means disposed between said connected chambers, operable by pressure of the fluid passing through the valve to the lower chamber and outlet for isolating the upper chamber from said fluid pressure.

3. A packingless fluid control valve comprising a casing having a fluid inlet and outlet, a valve plunger controlling the flow of fluid therethrough, connecting upper and lower fluid chambers in the casing capable of draining leakage fluid from the upper chamber to the lower chamber, said valve plunger having a part thereof passing through said upper chamber, and projecting through the upper part of the casing for operating connections, a breather in connection with said valve for venting the upper chamber to atmosphere, said lower chamber communicating with the outlet and means disposed between said connected chambers operable by pressure of the fluid passing through the valve to the lower chamber and outlet for isolating the upper chamber from the said fluid pressure.

4. A packingless fluid control valve comprising a casing having a fluid inlet and outlet and a valve plunger controlling the flow of fluid therethrough, said valve plunger being disposed to project upwardly through the casing, fluid drainage means in the upper portion of the valve, communicating with said plunger, operatively connected to the outlet to drain leakage fluid thereto, and means between the fluid drainage means and the outlet, operable under pressure of the fluid during its passage through the valve to the outlet, for isolating the upper portion of the valve from such fluid pressure, said valve plunger being provided with oil grooves for its lubrication in the area where it passes through the casing.

5. A packingless fluid control valve comprising a casing having a fluid inlet and a fluid outlet and a feed passage, a plurality of valve plungers controlling the flow of fluid therethrough between the inlet and feed passage and outlet and feed passage, connecting upper and lower fluid chambers in the casing capable of draining leakage fluid from the upper chamber to the lower chamber, said valve plungers having a part thereof passing through said upper chamber and projecting through the upper part of the casing for operating connections, said lower chamber being connected with the outlet and means disposed between said connected chambers operable by pressure of the fluid passing through the valve from feed passage to outlet, for isolating the upper chamber from pressure of such fluid.

6. A packingless fluid control valve as claimed in claim 5 in which a breather is included, designed to vent the upper chamber to the atmosphere.

7. A packingless fluid control valve as claimed in claim 5 in which the upper and lower chambers are connected by a common passageway, the latter having a partition therein formed with a port, and in which the means for isolating the upper chamber from fluid pressure consists of a check valve operatively carried in the partition and responsive to the pressure of the fluid passing through the valve to the outlet for closing the port in the partition.

8. A packingless fluid control valve as claimed in claim 5 in which the valve plungers are provided with circumferentially extending oil grooves in that area where they pass through the casing.

9. A fluid control valve comprising a casing having a fluid inlet and outlet and a valve plunger-

er controlling the flow of fluid therethrough, a feed passage connected with said inlet and outlet as controlled by said valve plunger, said valve plunger being disposed to project upwardly through the casing, fluid drainage means in the upper portion of the valve, communicating with said plunger, operatively connected with said outlet to drain leakage fluid thereto, and means operable under pressure of the fluid during its pressure flow from the feed passage to the outlet, for isolating the upper portion of the valve from said fluid pressure.

10. A fluid control valve comprising a casing having a fluid inlet and outlet, a valve plunger controlling the flow of fluid therethrough, upper and lower fluid chambers in the casing substantially at opposite ends of said plunger, a passage connecting said upper and lower chambers, said plunger having a part thereof passing through said upper chamber and projecting through the upper part of the casing for operating connections, said lower chamber being connected with said outlet, a breather communicating with the upper portion of said passage and the upper chamber for venting the latter to the atmosphere, and means disposed in said passage operable by the pressure of the fluid passing through the valve to the outlet for isolating the upper chamber from such pressure.

11. A fluid control valve as claimed in claim 10 in which the breather comprises a nipple-like member removably mounted in the casing communicating with the upper portion of the valve casing.

12. A packingless fluid control valve compris-

ing a casing having a fluid inlet and outlet and a valve plunger controlling the flow of fluid therethrough, said valve plunger being disposed to project upwardly through the casing, connecting means passing through the upper wall of the casing for connecting said valve with operating means exteriorly of the casing, a fluid drainage chamber in the upper portion of the casing, a drainage channel extending between said chamber and said outlet, and means operable under pressure of the fluid during its passage through the valve to the outlet for shutting off said channel and isolating the upper portion of the valve from fluid pressure.

13. A packingless fluid control valve as claimed in claim 12, including means for venting the upper portion of the valve to atmosphere.

14. A packingless fluid control valve comprising a casing having a fluid inlet and outlet and a valve plunger controlling the flow of fluid therethrough, said valve plunger projecting from the upper portion of the casing, for operating connections, said casing having upper and lower fluid chambers through which said valve plunger is designed to pass, said lower chamber being connected with the outlet, a passageway connecting said chambers designed to drain leakage fluid from the upper chamber, and a check valve in said passageway, operable in response to fluid pressure during passage of fluid through said valve to the outlet, to isolate the upper chamber from such fluid pressure, whereby said plunger may be mounted in said casing without packings.

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